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**ON THE MID- AND LONG-TERM THREAT TO THE  
U.S. GROUND COMBATANT**

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May 2000



**U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND  
ENGINEERING CENTER**

Close Combat Armaments Center

Picatinny Arsenal, New Jersey

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## EXECUTIVE SUMMARY

A basic thrust of The Joint Service Small Arms Program (JSSAP) is to explore revolutionary advances in small arms systems for the future ground combatant. The current program whereby we seek to realize this goal is The Light Fighter Lethality (LFL), central to which is the development of the lethality component for the ground combatant of the Army-After-Next. In order to facilitate the adequate underpinning for the program, we must—as an ongoing process—assess the future threat to the ground combatant. Specifically, our intent is to sketch the technical and operational threat environment in which the LFL equipped ground combatant may need to live and fight in the mid-(2005-2015) and long-term (2015-2020). It is with that goal in mind that this report was written.

This report is not intended to answer, definitively, questions regarding the threat to the future U.S. ground combatant. Rather, it invites the reader to enter into a conversation about the future—a future as seen through a glass darkly. For neither the pretensions of the author or the quality of the report source material will accurately point to some predestined future. This report is only an estimate of what the future might be, given current select trends and historical examples. However, the true object of the report is to equip the reader with a starting point from which he or she might expand upon the report's content and further engage its inferences by seeking out alternative interpretations. In other words this report constitutes the beginning of a process in which the reader must be an active participant. In this way, perhaps our collective vision might see the otherwise unanticipated threat before it becomes an overwhelming combat challenge to our future soldiers, Marines, airmen, sailors, Coast Guard personal, or special operators.

It must be noted that just as we are planning to arm and equip the U.S. ground combatant of the future, we can assume that our future adversaries will seek to do the same. Perhaps they will be more successful at it than we. While our industrial might and geographical isolation has historically saved us when we were caught napping, we will assuredly not be so blessed in future war. Our opponents may not allow us the luxury of their standing still while we bludgeon them. Moreover, their ground combatants may prove difficult to find, let alone to wound or kill. One matter for reflection is that the threat's Achilles heel could very well prove to be his under or over reliance upon technology—a situation, perhaps, ironically mirroring our own.

## THE THREAT 2020

“ONLY THE DEAD HAVE SEEN AN END TO WAR” – PLATO

### Introduction

Looking backwards at the military conflicts and wars of the 20<sup>th</sup> century, U.S. ground combatants have on occasion been ill prepared for the mode of fighting encountered in combat. Central to which is that combat readiness prefigures an adequate knowledge of the future threat. However, this is no simple matter. Accurately formulating the nature of a future threat is in equal parts difficult to achieve and correspondingly important to know. Were the problematic formulated in mathematics, it would be worthy of the likes of the brilliant physicist Stephen Hawking. However, if we decompose the future threat problematic down to its constituent parts we might succeed in making the future threat somewhat less opaque. With that approach in mind, this report seeks to examine the threat to the future U.S. ground combatant and his lethality component, or at least serve as a bold attempt. Additionally, this report sketches the technologies underpinning the types of small arms with which his opponent may be armed.

## Scope and Methodology

Part one of the report states its objective and its focal point, as well as, delimitations and assumptions. These provide parameters for the report. Next is the operational environment in which the U.S. ground combatant may find him or herself. The larger issues of the environment are considered first. Then attention is turned to the tactical environment in which the combatant will actually be required to fight. These environments include a variety of conventional and non-conventional models. Terrorism is addressed last, but its order of mention is in no way intended to detract from its importance.

Part two addresses the various types of technologies that might find their way into threat small arms architecture in both the mid- (2005-2015) and long-terms (2015-2020). It is presumed that threat small arms will continue to hold a special interest for our development community since small arms countermeasures are part and parcel of protecting our ground combatant.

Part three outlines the issues that surround the task of examining U.S. ground combatants as they are seen by the threat. That is to say as a target, and how threat forces may seek to destroy our ground combatants.

Part four focuses in on the Army slogans of "speed and information" or "speed and knowledge." These mottoes are in some ways evocative of what the Army hopes to attain with its human and material resources in future military actions, consequently this section of the report discusses a few bogies that could impair speed, slow the information flow, and perhaps keep information from being transmuted into knowledge. In this way, the report seeks to be interdisciplinary and examine how traditional and newly emerging technology might intersect with what threat small arms might be employed to accomplish in future battle.

With regard to methodology, this report employs two general modes of source data: (1) Historical examples serve as a mode of learning from the experience of others. Intuitively, we recognize that to ignore history is folly, but we need to temper such judgments with recognition of limitations inherent in the lessons of history. The defeats and mistakes of our civilian and military predecessors cannot provide precise lessons from the past—certainly the past is in no way compelled to repeat itself. History can nevertheless broaden our understanding of existent trends and serve as a guide to speculation about the future—if only to learn what not to do. For these reasons, historical inference and extrapolation off such inferences are central to the methodology of this report. (2) Given that looking forward can be useful albeit unscientific, extrapolation of trends in technical and tactical innovation are employed in order to envision what may be the case on the future battlefield.

"More than most professions the military is forced to depend upon intelligent interpretation of the past for signposts charting the future...the soldier makes maximum use of the historical record in assuring the readiness of himself and his command."

Excerpt from Annual Report of the Chief of Staff for the Fiscal Year June 30, 1931, General Douglas Mac Arthur



As a general orientation, the scope of this report will be limited to those areas and/or subjects relationally impacting upon the survivability and/or performance of U.S. ground combatants during the years 2005 through 2020. Lastly, although it is contrary to the nature of this report to be prescriptive, a summary and several recommendations are included as matters for reflection.

## **Background**

### **In the Shadow of the Cold War**

Is global instability the primary source of present and future threats? At the dawn of the 21<sup>st</sup> century, the global situation remains in a state of flux. The emergence of a competitor superpower to the United States has yet to make its appearance. A growing number of the developing nations—shed of the last vestiges of empire—still tend to define international respect in terms of the possession of nuclear weapons. The fracturing of Eastern Europe, resultant from the fall of the Berlin Wall in 1989, has yet to play itself out in terms of former Soviet satellites seeking integration in Western economic or military alliances—albeit that some satellites have already engaged the West in a positive manner. This instability bodes both good and ill for United States military forces. While Russia has seemingly declined as a military threat to the West, the castoff nations of its former empire have on occasion become the sites of ethnic cleansing. In short, United States superpower status can and likely will draw us into trouble spots. More often than not, such responses tend to take the form of ground forces sent to stop or prevent violence by the imposition of superior force. Outside of Europe, ruling elites in the Middle East, South-West Asia, and China all seemingly possess power aspirations that could well bring them—or others—into conflict with United States national interests. In summary, it is probable that the years 2005 through 2020 will chronicle the continuance of a dangerously unstable world—one in which the U.S. ground combatant must be able to cope and operate effectively.

If the changing nature of the threat drives our response to that threat, then the reason why we have an Army should be considered. This question is not simply answered by gesturing at the intuitive response, e.g., to fight our wars. Nor is the answer fixed rather it is eclectic. Although specifics are hard to isolate, we can obtain the general outlines of the Army's periodic re-invention by examining Army doctrine. We must continue to reevaluate our programs and reinterpret them in light of the emerging answers and formulate answers of our own regarding the lethality component of the U.S. ground combatant. Following are generic answers to the question as to why we have an Army, e.g., Fundamentals of Army Operations:

"War, (both limited and general) and two activities that [are] operations other than war—conflict and Army peacetime activities. Conflict comprises strikes and raids, peace enforcement, support to insurgency, antiterrorism, peacekeeping, and noncombatant evacuation operations. Peacetime activities employing or requiring Army forces include counterdrug operations, disaster relief, civil support, peace building, and nation assistance."

John L. Romjue, 1996. American Army Doctrine For The Post-Cold War.

## **PART I - OBJECTIVE, DELIMITATIONS AND ASSUMPTIONS**

### **Objective**

The object of this report is to prompt reflective thinking by small arms materiel developers and the small arms community on the future threat. It is hoped that this report will act as a starting point for an ongoing review of the mid- (2005-2015) and long-range (2015-2020) threat to the U.S. ground combatant.

### **Delimitations**

Any attempt at projecting the future nature of war or warfare is fraught with difficulties. Futurist studies are a decidedly soft science. This matter is further complicated by our scientific culture as we tend to be less than open minded regarding fields of study that are not reducible to empirically demonstrable facts. Therefore, we risk being myopic when it comes to the art of looking forward. Nevertheless, we cannot afford to rule out the utility of the educated guess—especially with regard to the future threat. In this way, we hopefully will avoid falling victim to “having planned to fight the last war.” It is in this optimistically unscientific spirit that this report is constructed. Lastly, this report is not intended as an all-inclusive document. Rather it is a targeted estimate covering several select areas in which a future threat might strive to exploit.

### **Assumptions**

#### **The Best Case**

The future operational mode of threat forces—in the years 2005 through 2020—will continue to rely upon classic direct and indirect fire kinetic-energy weapon systems. These systems will likely enclose a mix of calibers, some with bursting capability. Moreover, ground and airborne vehicles, as well as human musculature will continue to serve as primary threat weapon platforms. The preceding may be the case unless the threat achieves a radical breakthrough in new technology. Otherwise, the future battlefield will remain recognizable by contemporary military men and women.

Additionally, most of the important changes in the threat will be anticipated by United States defense planners, and subsequently countered by weapon developers by way of overmatch. United States budgetary climates will be uneven—making the improvement of our small arms conflicted.

#### **The Worst Case**

A dramatic shift in the nature of weaponry will occur—and with it the attendant obsolescence of many of the earlier generation small arms systems. Moreover, future threat small arms will steadily improve and dramatically expand or alter in their capability—all of which will prove difficult to anticipate. For example, future U.S. ground combatants will need to be able to defend against bursting munitions and seeker projectiles. Additionally, threat forces will field directed energy weapons of all types. Friendly forces will fight in the presence of incapacitation devices that can interrupt the functioning of our own sophisticated small arms systems. Threat weapon platforms will facilitate engagement from the air, land, sea, and possibly space. Moreover, threat forces will effectively

operate on a 24-hr basis, and be at least equally competent (technologically and tactically) to our own forces—under all battlefield conditions. Additionally, if they are technologically inferior to us, they will engage U.S. ground forces with asymmetric tactics—thereby offsetting our qualitative superiority. Additionally, several important changes in the threat will not be envisioned until such innovations are felt in combat. United States budgetary climates will decline precipitously making the advancement of our small arms inordinately difficult.

## **Operational Environmental: Macro and Micro**

### **Macro: Operation Environments**

**Conventional Battle (CB) and "War by Proxy."** With the break-up of the Soviet Union in the late 20<sup>th</sup> century, no nation of similar military stature has arisen to challenge United States superpower status. At the date of this writing, no competitor of that magnitude appears upon the time horizon. However, many well-informed academics and military pundits speculate about the designs of the People's Republic of China. It is possible that China might transform the world back into its bi-polar Cold War model—that which shaped warfare from the 1950s until 1989. Should this be the case, United States ground forces could find themselves *fighting on the margins* as exemplified by the Korean and Vietnam conflicts. Once again, the mutually assured destruction sustained by raw nuclear throw-weight might serve to fend off direct military confrontation.

In a recently published book entitled, Unrestricted Warfare, Chinese military officers Qiao Liang and Wang Xiangsui provide a cogent examination of future war and warfare from the Chinese perspective. This work is well worth reflecting upon as it affords us with a window into the minds of the professional officers of an emergent superpower. We cannot be dismissive of these men as simply dogmatic or syncopates, rather they represent what might be the tip of an iceberg and a potential force to be reckoned with.

"When people discuss future warfare, they are already quite accustomed to using certain weapons or certain technologies to describe it, calling it "electronic warfare," "precision-weapons warfare," and "information warfare." Coasting along in their mental orbit, people have not yet noticed that a certain inconspicuous yet very important change is stealthily approaching."

Unrestricted Warfare, 1999. Qiao Liang and Wang Xiangsui

**Techniques of Asymmetric Warfare.** A historically viable combat technique that has often been employed by a weaker opponent—one with its indigenous populace within the area of operation—is asymmetric warfare. Mao Tse-tung recognized this approach when he said: "that the guerrilla is like a fish that swims in the ocean of the people." His observation seemingly remains axiomatic for future U.S. ground combatants. Can our ground combatants effectively fight an enemy who blurs his identity with that of civilian non-combatants? This is especially the case if efficacy is defined by the absence of non-combatants casualties. Our historical responses—as was the case in Vietnam—to this question have militarily taken the form of search and destroy missions and the implementation of free-fire zones. Such solutions have demonstrable limitations. Regarding the small arms application, such approaches preclude ones sorting the enemy from non-combatants

until after the damage is done. Compounding this problem is the possibility that the future threat may use such methods, thereby severely testing the sensibilities of Western combatants. Given the difficulties inherent in this type of combat, what should our future small arms be able to do or refrain from doing?

### **Micro: Operational Environments**

**Close Quarter Battle.** This form of battle is conducted in situations in which ground combatants are by necessity constrained, e.g., urban areas, heavily wooded areas, mountainous areas, or swampy areas. Such areas are also known as hindering terrain. One traditional way in which a threat will seek to defeat our ground combatants is to engage them on terrain, whereby the enemy force is favored. Our military history is replete with examples of opponents who have expertly used close quarter combat—in hindering terrain—as a means of countering our strength. More to the point, we may be able to—and certainly should—design small arms in a way that optimizes U.S. ground combatant efficacy in hindering terrain. Moreover, the global spread of urban sprawl necessitates weapons that are low-collateral damage capable.

Trends in urban development make close quarter battle of increasing importance on a global scale, e.g., by the year 2015:

- 85 % of the world population lives in built up areas
- 300 cities have populations in excess of 1 million
- 70% of nuclear reactors are within cities

These stats infer that our engagement distance emphasis—for small arms development—should be based upon the statistical frequency of combat fighting distances rather than upon long-range as an overriding metric.

**Stand-off Battle.** Stand-off battle is conducted upon open terrain—such as that experienced on the deserts of South-West Asia by United States forces and allies during Operation Desert Storm in 1991. Another example of open terrain is that of Germany's Northern Plain—a key site of the long anticipated Soviet invasion during the Cold War. Stand-off battle is defined as combat taking place in which large intervals exist between enemy and friendly forces, and line-of-sight observation is generally unimpeded by man made or naturally occurring objects. As such, it tends to be dominated by the combatant whose weapons enable him to hit the enemy without the enemy being able to hit back. The technologically superior combatant usually commands the advantage in this type of battle, as the overmatch of enhanced sighting on weapon systems and improved munitions takes its toll on the less technologically sophisticated opponent. In summary, given that United States ground forces are equipped with small weapons possessing overmatch in long-range fire (and are well trained in the use of such weapons) they will tend to be able to dominate in open terrain.

**Terrorism.** Assuming that global instability continues to prompt United States military interventions abroad, and given that radical political, religious, or ethnic groups see us as supporting one side at the expense of the other, terrorism will likely expand as a prominent manifestation of future threat. This is made more probable still as our foreign policy seemingly links military global involvement with United States ethical responsibility. The upshot being that we risk inadvertently

generating hostility as a function of our smart bombs landing upon unintended targets. Mistakes such as these—or the perceptions of mistakes—can form the justifying schema of terrorist and thereby give rise to violence. Memories of hurts tend to be deeply ingrained and intermixed with feelings of ethnic or regional pride. Striking back may be delayed as explained by an old Arab axiom “the plate of revenge is best served cold.” This lag between cause and effect may be trans-generational, e.g. the Armenian Secret Army for the Liberation of Armenia—in the 1970s—justified its murder of Turkish citizens by gesturing at claims of a Turkish genocide of Armenians in 1915. In summary, U.S. ground combatants have been and will most likely remain the target of terrorist attacks. Terrorism can manifest itself in a myriad of forms ranging from unconventional combat to criminal activity. As such, it is particularly difficult for conventional forces to fight—offensively or defensively—against such an illusive threat. Following is a definition of terrorism:

“Terrorism: (1) An organized pattern of violent behavior designed to influence government policy or intimidate the population for the purpose of influencing government policy. (2) Terror: violence committed by groups in order to intimidate a population or government into granting demands. (3) Terrorism may be defined as violent, criminal behavior designed primarily to generate fear in the community, or a substantial segment of it, for political purposes. (4) Terrorism is the culturally unacceptable use or threat of violence directed toward symbolic targets to influence political behavior either directly through fear, intimidation, or coercion, or indirectly by affecting attitudes, emotions, or opinions.”

James A. Poland, Understanding Terrorism

**Inferences.** The global trends of the Post Cold-War period are seemingly our unchallenged superpower status, growing instability in the developing world, and the apparent devolution of the nation-state. In such trends lay the trajectory of an archetypal threat whose strength is paradoxically in its own weakness—asymmetrical warfare. This warfare, along with its adjunct terrorism, can be defined by its artful use of limited resources by a militarily weak force to effectively offset the strengths of a more powerful military force. All of which infer that these David and Goliath fighters will threaten our ground combatants. Therefore, small Arms should be adaptable to the realities of asymmetrical combat.

## **PART II – SMALL ARMS: MID- AND LONG-TERM**

### **Mid-term Small Arms (2005-2015)**

#### **In General - Kinetic Energy**

How might the small arms community interpret the facts regarding future threat small arms? One way to approach this problem is to first define the facts of threat small arms, e.g., what sort of hand-held, shoulder-fired, and crew-served small arms might be the threat weapons of choice? Generically, these weapons might be similar to those outlined in table 1. This is not a bad starting point. These types of small arms—and the technologies they represent—remain the staple individual and crew weapons of both friend and foe since the end of World War II. They are tried and tested and known to be effective as evidenced by historical wound ballistics data. Such systems—albeit improved—will likely play a role in future combat well into the early decades of the 21<sup>st</sup> century.

"The urban guerrilla's arms are light arms, easily exchanged, usually captured from the enemy, purchased, or made on the spot...[and] shotguns can be useful at short range. They are useful even for a poor shot. The urban guerilla should not try and base his actions on the use of heavy arms...lightweight weapons insure mobility and speed.

Carlos Marighella, Handbook of Urban Guerilla Warfare.

Threat forces will probably continue carrying kinetic energy small arms into battle—well into the future, as may be the case with proxy threat forces, e.g. unconventional forces, terrorists, and trans-national drug traffickers. However, we should not complacently assume the lack of sophistication with regards to proxy or renegade threat forces. Some unconventional groups would likely have access to advance technological capability. They may choose to demonstrate lethal instruments in uniquely destructive ways, e.g. against relief workers and/or the civil populace. Lastly there might be the odd or peculiar situation, one where our own strengths might inadvertently work against us as happened to federal law enforcement during the BATF/FBI operation in Waco, Texas and the Ruby Ridge Incident of the early 1990s.

Table 1  
Typical KE Weapons

Category & type	Effective range (m)	Calibers
Assault rifles	400-500	5.45 mm & 5.56 mm
Light machine guns	400-800	5.45 mm & 5.56 mm
General purpose machine guns	800-1000	6 mm & 7.62 mm
Heavy machine guns	<2000	12.7 mm & Cal. 50
Sniper Rifles	Anti-personnel <1000 Anti-Material 1500-2000	7.62 mm 300 mag. Cal. 50 12.7 mm 15 mm
Shoulder-fired grenade launchers	300-400	
Automatic grenade launchers	1700-2000	30 mm 35 mm 40 mm

## Kinetic Energy Summary

"Personal weapons must be compact and robust, with a high rate of fire and very lightweight ammunition, but there is also a place for shotgun-like weapons at the squad level. [Urban] fighting is utterly exhausting and requires specialized mobility tools."

Ralph Peters, Fighting for the Future.

The first hand cannons appeared around the middle of the 14<sup>th</sup> century. In the interim, the push of technological development—and the pull of User need—has led to the manufacture of small arms of dramatically increasing probabilities of hits and kills. Speculating upon the azimuth of technological trends—those that will seemingly be the case in the first two decades of the 21<sup>st</sup> century—threat small arms might include such improvements as: (1) lighter system weight—enhanced personal defense weapons; (2) reduced caliber—improved logistical attributes and more manageable recoil; (3) increased magazine capacity—added firepower; (4) improved ammunition lethality and capabilities—to include armor-piercing bullets, and, possibly, bursting munitions; (5) sighting devices/fire control—in this area optics coupled with inputs from on-board ballistic solution computers and wind-sensing technologies may be combined in order to accurately compute the projectile's point of impact, and a proliferation of inexpensive night vision devices and/or thermal imagers may afford the threat with a viable 24-hr tactical capability; and (6) ancillary mounting rail for the mix and match addition of grenade launchers, shotgun barrel, red-dot collimators/aiming lights, flashlights, etc.

### In Particular – Kinetic Energy

During World War II, the Allies fired an average of 25,000 bullets for each enemy soldier killed...in Korea [United Nations troop] expended 50,000 rounds for each enemy dead. In Vietnam [U.S. troops] burnt up in excess of 200,000 bullets to get a single body count...*statistically, it takes 1.3 bullets for a trained sniper to kill an enemy*<sup>1</sup>.

**Sniper Weapons:** The scoped precision weapon of the small arms family, a.k.a. the sniper weapon, has been a highly lethal part of military history since the time of the American Civil War. The sniper weapon's distinguishing feature is its capability to hit targets with precise accuracy and at distances that extend well beyond that of the more rudimentary individual combat weapon. Threat forces have a rich and bloody heritage of effectively employing snipers against United States ground forces. As long as such mission specific weapons are not eclipsed by the advent of individual small arms that possess superior accuracy, sniper weapons will continue to kill or wound a significant number of U.S. ground combatants—especially key leaders and vitally important crew-served weapon operators. In addition, large caliber sniper weapons are becoming increasingly useful as anti-materiel weapons—effective against thin-skinned vehicles, generators, communication-vans/antennas, etc.

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<sup>1</sup>Charles W. Sasser and Craig Roberts, One Shot-One Kill.

The importance of the sniper has historically been marginalized by much of our Army leadership. We tend to see mission specific sniper weapons as being little more than commercial and/or service-individual weapon makeovers. Snipers are seemingly perceived as ill deserving of a weapon as specialized as they are. Our hand-me-down mindset is evidenced if one examines lineage of the Army sniper weapons for the past 100 yrs, retrospectively. The current M24 sniper weapon system is a modified commercial Remington M700 bolt-action rifle. Its predecessor the M21 sniper weapon was a modified M14 semi-automatic service rifle. Prior to that, the M1D sniper weapon was a modified M1 grand service rifle, and prior to that the 1903A4 sniper weapon was a modified M1903 service rifle—and so it goes back to the time of the America Civil War.

“Our military structure and equipment were changing so rapidly that even the comforting old slogan ‘tried and true’ was gone. In its place had sprung up a disquieting one: ‘If it works it’s obsolete.’”

Dwight D. Eisenhower commenting on the military changes that took place during his Presidency (qtd. In Walter Millis, American Military Thought.)

**Seeker Projectiles.** The classic small arms kinetic energy projectile is essentially a dumb round in that it possesses no on-board ability with which to adjust its trajectory. In the larger munitions categories, such as artillery projectiles and aircraft-launched missiles, the advent of so-called smart munitions have redefined the parameters of precision attack, generally through the innovation of guided and unguided smart projectiles. At the time of this writing, interest in small arms seeker projectiles has taken the form of an approved science and technology objective (STO). Under the name of the Light Fighter Lethality (LFL) program, JSSAP is pursuing the development of a fire-and-forget seeker projectile for small arms application. Certainly, it should be expected that our potential foes should not be far behind us in attempting to mirror or exceed our efforts in this newly emerging field of small arms systems. Such projectiles might offset the classic infantry protection of movement and cover.

**Bursting Munitions.** Of all the possibilities for improvements to kinetic energy weapon systems, bursting munitions offer perhaps the single most qualitative improvement to this very mature technology. As such its development and/or usage by threat forces is a matter of grave concern regarding our own ground combatants. Shown next is an excerpt from a briefing-chart for the JSSAP Objective Crew Served Weapon program—central to which is the development of bursting munitions.

**The Objective Crew Served Weapon (OCSW).** This effort will develop and demonstrate a lightweight, truly 2-man portable, crew-served weapon system providing the dismounted soldier with overwhelming lethality resulting in increased survivability through long range (out to 2,000 meters) defeat of protected personnel targets in defilade. Demonstrate armor piercing warhead potential to defeat lightly armored vehicles, water-craft, and slow moving aircraft out to 2,000 meters.

-In FY 99, demonstrate threshold AP warhead light armor penetration of 2" (51mm) Rolled Homogeneous Armor (RHA) or with a goal of penetrating 51 mm High Hardness (HHA) out to 2,000 m<sup>2</sup>.

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<sup>2</sup>JSAAP OCSW Program, January 2000.



-In FY 00, demonstrate from a lightweight (<50 lbs.) weapon system (gun, pintle, T&E, and tripod) to include: a fully integrated fuze functions of airburst, point detonation, self-destruct, rapid-fire (burst-mode) with target practice rounds, increased robustness of fuzing and fire control designs, and the demonstrating of demonstrate thermal module interface capability<sup>2</sup>.

-In FY 01, demonstrate gun-launched (burst-mode) airburst utilization of integrated crew-served control (leveraged from Objective Individual Combat Weapon ATD; STO III.I 1), Land Warrior interface, and thermal module capability<sup>2</sup>.

-In FY 02, conduct safety & technical tests, User training through virtual simulations, and an early operational assessment through a Dismounted Battlespace Battle Lab Experiment, and operation utility, technological maturity and achievement of exit criteria<sup>2</sup>.

**Grenade Launchers.** No significant changes in grenade launchers are expected for the next 20 years. It is likely, however, that within the next 20 years, automatic grenade launchers will replace small-caliber mortars in many military units. The versatility of these systems provides effective direct-fire suppression capabilities at close ranges and, in some cases, as with the AGS-17, good indirect-fire capabilities as well<sup>3</sup>.

**Hand Grenades.** During the next 20 years, few technological advances will occur to significantly increase the terminal lethality of hand grenades. Size constraints and desired performance characteristics limit radical changes in grenade design. While attempts have been made to field hand grenades with all-ways-acting or impact fuzes (and they will become standard in many grenade systems), it is doubtful such fuzes will be adopted universally. Complexity in design, higher probability of fuze malfunction, and increased production costs outweigh most of the advantages of these fuzes. Advances in explosive-fill technology may lead to a slight increase in grenade lethality, as might the use of explosive wave shapers designed to improve fragmentation patterns. A few countries have incorporated improved explosive fills and wave shapers in their grenade designs, even though the addition of these technologies provides only marginal increases in grenade lethality. The low cost and ease of incorporating these improvements, coupled with today's competitive weapons market, however, make even marginal increases in lethality worth pursuing for some weapon dealers<sup>4</sup>.

**Antipersonnel (AP) Landmines.** Will remain a major threat to the individual soldier for the foreseeable future. However, booby-traps and unexploded ordinance (UXO) should not be overlooked as they pose the same or greater threats to the soldier. AP mines will be found in all conflicts levels, ranging from operations on complex/urban terrain to Major Theater of War (MTW). The most common AP mines will be fragmentation and blast. Most will contain little or no metal parts, and will be pressure and/or tripwire initiated. AP mines can be hand-emplaced, scatter-able, surface laid or buried<sup>5</sup>.

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<sup>2</sup>Ibid.

<sup>3</sup>U.S. Army Infantry Center, Intelligence Operations Division, Directorate Intelligence, Fort Benning, GA, Small Arms Threat.

<sup>4</sup>Ibid.

<sup>5</sup>Ibid.

## **Long-term Small Arms (2015-2020)**

Two examples of "thinking outside of the box." Weapons developments that were decades ahead of their time:

In 1922 the [German] Weapons Office wrote the specifications for a new light machine gun that, in accordance with the new tactics emphasizing the firepower of the forward units, would have as high a rate of fire as possible.

In 1923 General von Tayson, [German] inspector of infantry, requested the Weapons Office to develop an automatic rifle for the infantryman. Von Tayson advocated a semiautomatic rifle with ballistics similar to the 98 Mauser and a magazine holding 20-30 rounds<sup>6</sup>.

## **Directed Energy Small Arms**

The future threat will most likely remain proactive in directed energy research and development for small arms—should we do no less?

"Buck Rogers" disintegrator "ray-guns" were fictional artifacts of the 1930s. Might such weapons become the threat reality of the future? At the dawn of the 21<sup>st</sup> century, laser-light, microwaves, particle beams, and sonic wave technologies have been a source of much speculation and investigation amid the United States weapon developmental community. No doubt there is much potential in this area. However, expectations have generally remained unfulfilled as seemingly insurmountable difficulties attending target coupling, beam propagation, power requirements, and even international legalities delay their development. What we should take from this state of affairs is not resignation. Rather we had best admonish ourselves not to be presumptuous enough to assume that the threat weapon development communities will not find answers before we do.

"[In the years before the first and second World Wars] Germany would gain a reputation for building tomorrow's weapons today [and the] United States would be content to build yesterday's weapons tomorrow."

James A. Huston, The Sinews of War.

**High Power Microwaves (HPM).** High power microwaves can cause the disruption and/or destruction of electronic circuitry. This could very well be of consequence for the future U.S. ground combatant, in the sense that digitization of the battlefield will most likely involve a significant addition of integrated circuits to the combatant's fighting system. The same might apply to personal communications systems and other ancillary digital equipment. Special consideration of this threat is warranted as our reliance upon electronic devices expands. The counter measure to this threat lies in part through the hardening of all electronic equipment intended for use by the U.S. ground combatant.

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<sup>6</sup>James S. Corum, The Roots of Blitzkrieg, 1992.

**Particle Beams.** The two basic types of particle beams are (1) the electronically driven and (2) the explosively driven. Their target effects include explosive detonation, structural damage, electronic component upset, and human incapacitation (non-lethal to lethal). Both types emit power for a very short range—as of the date of this report—and therefore may need to be bussed out to, and detonated near, the target.

“What I have to say is this: In the preparations for national defense we have to follow an entirely new course because the character of future wars is going to be an entirely different from the character of past wars.”

Italian Major General Giulio Douhet, military theorist of airpower, 1921.

**Lasers and Optical Technologies.** Lasers and optical weapons can damage vision in the human eye. This is a function of the wavelength of the light energy and in this sense, it can damage different parts of the eye:

- The blue end of the electromagnetic spectrum affects the lens of the eyes
- The visible region affects the retina
- The red end affects the cornea

Moreover, the damage to the eye can be increased by order of magnitude, if the person is looking through unfiltered direct-view optics. This is due to the aperture of the optics being greater than the human eye, and therefore, collects more light energy and directs this light energy into the eye. Aside from retinal damage, laser and optical technologies can temporarily reduce visual acuity by the use of glare and flash-blinding/dazzle. Although the damage mechanism is rarely lethal, the loss of visual acuity may impair the victim's ability to complete his combat mission. Regarding material targets, lasers and optical weapons have demonstrated their viability against electro-optics. In addition, lasers can be used to detect the presence of optics on the battlefield, and as such can identify the location of friendly-forces snipers looking through riflescopes and forward observers employing binoculars. Due to the lethality issues present at the date of this writing, laser and optical weapons may have a limited appeal for threat forces, e.g., would a threat combatant discard his kinetic energy weapon for a “light-stick?”

In summary, human vision and combat activities are inextricably linked—blinded warriors are tantamount to combat ineffective warriors. The mere threat of being blinded by the enemy tends to be both physically and psychologically debilitating. Given the fact that lasers and optical weapons can impair or destroy human sight, such weapons are a potentially grave threat to ground combatants. As a closing and important note, lasers can do bodily damage beyond that of the human eye. There are certain lasers that can form plasma on the surface of the target. Repeated pulsing on the same area may cause blunt-trauma. These photons of light attack the body as though being hit by a baseball bat. Lastly, CO2 lasers can set clothing on fire.

**Acoustics.** It is self-evident that sound can hurt and disorient human beings—anyone caught off guard by the blast of an air horn will attest to this fact. However, the capacity to turn sound into a viable weapon system has long eluded developers. Attempts to make an acoustic weapon date back at least to the experiments of Germans scientists during World War II. Recent efforts by several of the national research and development centers have resulted in the design, fabrication, and testing of various sound devices which have produced sound pressure at high intensities. The preliminary results of these initial investigations show that high sound levels may result in permanent hearing damage and possibly damage to internal organs located in the chest cavity. The technological innovations of early decades of the 21<sup>st</sup> century may finally solve the attendant problems of directionality and attenuation. A combat-effective sound weapon might be employed on the battlefield as a means to shock or demoralize U.S. ground combatants<sup>7</sup>.

### **Inferences**

The upward curve of technological innovation is flattening for conventional weapons due to the maturity of kinetic energy. Resultantly, the vertical proliferation of such technologies seemingly offer only a few more significant refinements—albeit important ones, e.g., bursting munitions that offer significantly increased probabilities of hit and kill than do more rudimentary types of kinetic energy weapons. The horizontal proliferation of kinetic energy small arms continues apace as the developing world modernizes its ground forces. In the coming decades, we might expect even the poorer countries or groups to possess good quality fully automatic and semi-automatic small arms systems. The wild card of small arms possibilities is the specter of practicable directed energy small arms systems being developed by technological advanced countries in Europe or the Pacific Rim, and such systems being transferred—legally or otherwise—to groups hostile to the United States.

## **PART III – HUMAN TARGETS AND THEIR DEFEAT**

Given what we do not know about target effects and human incapacitation, it seems apparent that modeling of ground combatants—to approximate how combatants actually function in combat—be coupled with wound ballistics. Moreover, the product of such modeling should inform the nature of functional architecture for small arms design. Human incapacitation and tactical application is the nexus of small arm design.

“Incapacitation [of a human being by gunshot wounds] has a great deal to do with exactly what tissue in the body was engaged by the bullet. Strangely, it sometimes is not related to the actual severity of the wound. Neither is incapacitation otherwise known as “stopping power,” necessarily related to killing power [lethality]. A person can receive a lethal injury and remain hostile for relatively long periods of time. Likewise, a person can receive a nonlethal injury and fall to the ground, inert, relatively quickly.”

Evan P. Marshall and Edwin J. Sanow, Handgun Stopping Power

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<sup>7</sup>For additional information on directed energy weapons see JSSAP Future Small Arms Conclave “Blue Sky” 2020, pp. 31-34, September 1997, TCN 97-047. And New World Vistas--Air And Space Power For The 21<sup>st</sup> Century, Directed Energy Volume, USAF Scientific Advisory Board, December 1995, and JSSAP Future Technology Conference, pp. 15-41, June 1993, ARCCD-TR-93012.

## A Forensic Perspective—Attacking The Physical Self?

Human beings will most likely remain a sought after target of weapon systems, as has been the case for nearly 80 centuries. Small arms terminal effects will probably continue to attack human "flesh and blood" by tearing, puncturing, and creating wound cavities. Human bodies as media present a vulnerable assemblage-composite of water-filled tissue (thorax and abdomen). The entire body is kept erect by way of a light internal frame (skeleton), and the entire being is actuated by several ounces of a fatty tissue (wet-ware) central processing unit (a.k.a. the brain), all of which is given mobility and animation by stringy-tissue (muscle) that composes much of the mass of the limbs (arms and legs) and some of the torso.

Aside from target composition, the equally important issue of human target exposure exists. What is it that exactly constitutes the dimensional aspects of the human as a target? A way of looking at this issue is the ideal target exposure versus the probable target exposure. Ideal target exposure is exemplified by a ground combatant standing on the crest of a hill silhouetted by sunlight. Probable target exposure is exemplified by the fleeting glimpse of an arm or boot heel in a wood thicket. For a few quantitative estimates regarding human targets, see tables 2 and 3—they indicate movement and dimensional information, and pertain to the classic foot-mobile Infantry soldier.

Table 2  
Historic man target engagement data\*

	Typical distances in meters	Typical exposure times in seconds
Jungle & MOUT	<100	3-5
Most scenarios (90%)	<300	5-7
Desert	>300	5-7

\*Note: Exposure times appeared to be influenced by the availability of cover and concealment and the volume of suppressive fire. Most target exposures for close-in battle were during the movement phase of the assault—enemy soldiers moved at a rate of approximately 3 m/s for short rushes while assaulting.

Table 3  
Dimensions in meters

Man as a target	Width	Height	Area (M2)
Standing	0.454	1.486	0.675
Crouching/ kneeling	0.495	0.861	0.426
Prone	0.660	0.353	0.232
Foxhole	0.495	0.375	0.186

Tables 2 and 3 and note: Atlantic Research Corp. Defense Systems Division, Threat For Infantry Small Arms (undated) p. 2, 27.

## Genetic Engineering—Making the Physical Self More Resistant?

Having just discussed the historic constancy of the human as a target, we turn now to a brief mention of the possibilities for the human target being hardened. Newly emerging trends in genetic engineering might make human beings resistive to the terminal effects of small arms. Consider that humans have biologically been endowed with weak jaws and poor organic fighting capacity and that our genetic forbearers would have certainly been killed-off by large macro predators—during the Paleolithic period—had it not been for our tool-making capacity. We have long survived by cunning and tools since then, but might we be reaching the point where we could be physically enhanced? This is not to suggest that claws and sharp incisor teeth are in the offing, but perhaps medical scientists might be able to alter human immune systems, make flesh or bone tougher, or improve muscular performance and mental acuity. Such fantasy is nearly transformed as new techniques in cloning, improved understanding of the Neurological basis of memory and motor programs, and advances in DNA mapping make human alteration as a possibility not as outlandish as it might have appeared only a few years ago.

## Morale/Psychological Effects—Attacking the Will/Resolve?

“And the physical effect [of technology] is not the only effect to which we have to take into account; it is the moral effect we are in search of, and there is no other way of learning and estimating but by experience. In the Middle Ages, when firearms had just been invented, their physical effect, owing to their imperfect construction, was naturally trifling compared to what it is now, *but their moral effect was much greater.*”

Karl Von Clausewitz, 1832, On War.

Can weapon enhancement capitalize upon both physical and morale-impairing target effects? The psychological component includes systems, devices, or agents attacking the ground combatant's will. Often overshadowed by the physical threat to the ground combatant, the moral threat is rooted in anxiety without a definite object. Such disembodied fears can impair or destroy one's resolve to continue fighting. This might be exemplified by the terror of what a threat weapon might do to one's self or comrades—as opposed to the actual reality of the effects of the weapon. It is important that the physical and psychological aspects of weapons not be considered as separate and distinctive in their effects—the two are interwoven, e.g., the fears resulting from overwhelming firepower and/or precision targeting are representative of the type of weapon effects that strike at the human mind as well as at the body. Future threat weapons may be more effective in creating terror than causing bodily destruction.

## Chaos and Unit Cohesion—Attacking Man's Social Connection?

“War is aimed at destruction. The fire and the general purpose of the enemy are directed against one's own personnel, material, and communications, and the object of keeping one's own design from coming into play. Small plans miscarry because the wrong man happens to be hit at the critical moment or the guns which were counted upon are knocked out of action.”

S.L.A. Marshall, S.L.A. Men against Fire.

How might threat small arms create chaos among U.S. ground combatants and thereby destroy unit cohesion? Chaos is the opposite of good order, and military good order is the result of unit cohesion. So, how might the future U.S. ground combatant be rendered less likely to devolve into chaos in battle? Threat weapons that shock or surprise U.S. ground combatants might trigger an uncertain apprehension that erodes unit cohesion. When ground combatants are made uncertain as to the capability of their comrades, weapons, or leaders to protect them, then unit cohesion will suffer. For the ground combatant, this uncertainty occurs on the tactical level—and hence the significance for United States small arms, especially if threat small arms cannot seemingly be defended against.

### **Identification Friend or Foe (IFF)—Attacking One's Own?**

On the future battlefield, will U.S. ground combatants continue to fall prey to friendly fire? Fratricide is a function of the chaos of combat, but that is of little solace to the comrades of those killed or wounded. Yet the solution of simply ending fratricide has eluded the best efforts of even the great captains of military history. Given that the disorder attending the killing of ones own people or noncombatants may elude complete elimination, the addition of anti-fratricide technological safeguards to small arms systems would be a worthy step in the right direction.

### **Future Threat Garments—Attack by the Stealth and/or Invulnerable?**

Given recent trends in protective garments, small arms projectiles might one day be rendered obsolete by innovations in such battle-uniforms.

#### **Chameleon Uniforms**

Might an unseen or invulnerable foe attack the future U.S. ground combatant? The reality of an enemy moving about virtually unseen on the battlefield would pose a significant threat to all friendly-forces ground combatants—you cannot hit what you cannot see. Certainly, personal concealment has long been an elusive dream of the individual combatant. Historical trends in the 20<sup>th</sup> century have seen field gray and kaki field uniforms give way to less conspicuous camouflage pattern uniforms. The issue of how not-to-be-seen continues to drive the life expectancy of the ground combatant. The enemy uniformed in clothing that perfectly match the colors of ones background—like a Chameleon—might redefine the nature of ground combat. Humans as targets represents an assemblage of visual, auditory, tactile, and thermal cues. If a reliable profile of these cues can be discerned by sensors and separated from the cues of non-targets, then the spotlighted humans will pose lucrative targets for the future threat.

#### **Body Armor and Helmet Technologies**

Equally threatening to U.S. ground combatants would be the existence of opponents equipped with body armor of a type that is totally or nearly impervious to bullets and/or bursting projectiles. Historically, attempts of this type have been overcome by improvements in the hitting power of weapons, e.g., medieval knights once possessed armor that protected them against all but the most violent blows of lance or axe. However, the advent of kinetic energy weaponry soon relegated their armor to that of mere display. Totally effective body armor development has continued to remain an illusive goal. Although improved bullet resistive vests have reappeared in the late 20<sup>th</sup> century, all but the most cumbersome are relegated to defeating relatively low velocity bullets and

spent shrapnel. A variety of innovations might radically alter this situation. Such are the emerging trends in bodily protective equipment: high hardness steel plate amid fiber, flexible honeycombed ceramic armor, human eye ballistic protection goggles, and shock-absorbing helmets.

Table 4  
Example: contemporary protective vest

Description	Composition
	Full torso protection Back 430 mm Front 430 mm
	Layers with metal plates (Titanium)
	20 layers of Kevlar

## Inferences

Wounding is more than a forensic event. Were the human being a material target, this part of the report would be much less complex. For ground combatants are not simply targets, they are conscious beings. When exposed to the horrors of the combat, they promptly develop and deploy a variety of coping strategies. During the ground combatant's initial exposure to the combat, the wounding and killing of one's comrades tends to be perceived as an event independent of and apart from oneself—it is something which happens to the ubiquitous other guy. As the duration in combat extends into days or weeks, this feeling of insulation from morbidity and mortality begins to wane as the randomness of terror takes its toll. His imagination projects upon his personal possibilities the absence of personal future. Historical examples of this can be identified in the practice of American Civil War soldiers pinning identification notes on their uniforms prior to going into battle. The perception of life expectancy adjusts to the conditions under which the combatant finds himself. This is perhaps the difference between the veteran and the novice combatant, that is to say one's capacity to grasp the utter precariousness of survival in combat. As a correlation forms in the mind of the combatant between those taking risks in battle and those dying—or being severely wounded, the observant combatant is dissuaded from taking all but the most necessary risks.

The impact of psychology of wounding upon the cohesion of the command can range widely. The combatant may see his risk of exposure as a function of time under fire. During the Vietnam War this was prescribed as 6 months for officers and 1 yr for enlisted men. The status of being a short-timer became both a blessing and a sort of curse as the possibility of getting hit seemed more untimely than ever, and yet the glimmer of relief from stress remained within arms reach. In WWII, the outlook of the combat infantryman was quite different as U.S. Army commanders kept combatants in the line often times until the last combat veteran was killed in action (KIA) or wounded in action (WIA). Faced with this reality, WWII infantrymen became fatalistic and hardened in a way that their Vietnam counterparts perhaps rarely could.

As the extreme fear of being wounded melds with a wildly oscillating mixture of excitement and terror that besets the combatant, he may freeze completely. Or he may—under the urging of determined leaders—continue to act in a sort of automatic mode of behavior loosely based upon his



recollection of immediate action drills learned in the training base. The veteran combatant will respond most strongly to the insights that he has secured through his observations of combat pragmatics, e.g., that which works and does not result in his being killed. Another central factor of wounding in combat and its relation to the combatant is his role as a social being. As such he is embedded in a social context that few—if any civilian setting—could approximate. Shared hardship and trust built upon life and death circumstances forge a bond that transcends ordinary interpersonal relationships. Care between combatants in its most idealized form is a blurring of instinctual self-preservation with that of the survival of the primary group—the fire-team, squad, platoon, or company with which one suffers in combat. For all the aforementioned reasons, combat wounding must be examined holistically, with both a psychological and a physical perspective. Moreover, our look at human incapacitation and wounding should recognize that the mind and body are a unity—a unity upon which hangs the combatant's will to continue fighting.

“They (soldiers) wish to hell they were somewhere else, and they wish to hell they would get some relief. They wish to hell the mud was dry and they wish to hell their coffee was hot. They want to go home. But they stay in their wet holes and fight, and then they climb out and crawl through minefields and fight some more.”

Bill Mauldin, WWII news correspondent.

## **PART IV – THREATS TO SPEED AND INFORMATION**

### **Threat Intensionality**

Regardless of the identity of the future threat, they will certainly try to disrupt our intended actions. One way in which they may pursue disruption is by seeking to understand the actuating motives behind our projects. Comprehending our intentions is fundamental to their developing effective countermeasures to the same. All of which begs the question: how do we cue the threat regarding U.S. Army intentions? Army doctrine informs both friend and foe of that which we plan to do on the future battlefield. A close reading of our doctrine will sketch the future battlefield as the Army envisions it: unimpeded movement with great speed and forces guided by the certainty of knowledge.

“If you know yourself and know the enemy, you will win every battle. If you know yourself, but do not know the enemy, you will win one and lose one. If you do not know yourself or the enemy, you will lose every battle.”

Sun Tzu, The Art of War.

### **Performance Degrading Threats—Lethal and Otherwise**

History gives ample evidence of small arms unsettling the morale of even a jaded ground combatant by hitting him from unexpected quarters and through ambushes. This is relevant for the future as we seek to stay inside the decision loop of an enemy commander. Central to this goal is to be better informed than one's enemy in a way that is meaningful and to act or move upon such information with speed that outstrips the enemy's attempts to gain the initiative. Simply stated, it is

rapid and intelligent action. The contemporary doctrine as espoused by U.S. Army Training and Doctrine Command (TRADOC) has as its locus this theme. However, might a future threat seek to counter our doctrine by way of classic or radically new ambushes? Threat weapons might be uniquely adept at creating uncertainty and fear in our forces that will slow movement. Our aspirations for seeing the battlefield might be occluded by a host of threat bogies aimed at causing our command and control centers to conflate erroneous information with knowledge. Moreover, the esprit of junior leaders might be negated by unseen and unexpected threats. In short, our aspirations must be realizable in the face of threat forces. So a few of the newly emerging and the classical frictions of war are outlined below with more questions than answers.

### **Robots and Cyber Scouts**

Might machines replace men in ground combat? The genesis of the "information age" has created the possibility that threat scouts might be supplanted, at least in part, by intelligent cyber scouts. Even that computers cannot be made to think in the sense that humans do, that is with intentionality, motives, feelings, or esprit—they may be able to function as a new form of scouts. Such intelligent machines could collate information by penetrating United States command and control networks. Additionally, there is the specter of threat intelligent machines equipped with transponders and possibly configured as insects or perhaps small enough to be ingested by human beings.

### **Ground Attack Aircraft**

The nemesis of the ground combatant in the 20<sup>th</sup> century has frequently been death from above, e.g., the ground attack aircraft. Although U.S. ground combatants have typically not found themselves on the receiving end of this threat, this situation could very well change in the future. Between the years 2005 to 2020, U.S. combatants might find that movement on the battlefield is no longer practical. Threat aircraft moving erratically and with great rapidity at nape of the earth levels armed with weapons that can see ground troops in all conditions could sweep the battlefield of the living—such aircraft might even be unmanned. Future threat aircraft may elude our countermeasures by being stealth and cloaked from detection. Individual protection might require ones small arms to double as an anti-aircraft system.

### **Depolymerization Agents**

Will our speed be impeded by a threat attack that renders inoperable our weapons or turns our vehicle tires into mush? To be disarmed is to be defeated. To be stopped is to be disabled. Depolymerization agents may do both. Agents of this type act as a catalytic agent. It attacks the polymer bonds in various target materials, such as rubber tires; only small amounts are required to secure the desired target effect. Technologically advanced small arms may be especially vulnerable to agents that attack the physical-architecture of the system. Therefore, we need to model such threats in a way that might help us better understand how they could be employed against future U.S. ground combatants. One way of protecting small arms from disabling technologies may be to build in soft-failure redundancy whereby our weapon might still function in a impaired mode.

### **Biological, Chemical, and Nuclear**

The stalemate that led to trench warfare during World War I was not exclusively a function of machinegun and artillery fire. The employment of gas warfare did much to limit mobility and maneuverability, hence speed on the battlefield. Might new variants of this approach find its way back into

future warfare? Western countries are seemingly resistive to its use, but will the same moral brake take hold in the developing countries? Short of garments that provide full encapsulated protection, the U.S. ground combatant could remain threatened by exposure to a myriad of substances airborne and otherwise, such as poisons and bio chemical agents. Additionally, it should be noted that ground combatants wearing protective garments are typically less effective in their employment of small arms. All of which warrants consideration regarding how the threat may seek to slow down our forces.

The wild card of ground combat remains the battlefield use of nuclear weapons. Will small and clean nuclear weapons change the future battlefield? If so, speed might take on a meaning that is wholly unintended by United States military planners. This prospect is made more troubling by the continued horizontal proliferation of nuclear weapons. In recent (1999) statements by Russian leadership, that infers nuclear weapon usage in situations in which Russian national survival is not the issue.

### **Direct and Indirect Large Caliber Fire**

Sources of information and the speed of one's ground combatants can be degraded or destroyed by artillery and/or rockets. Historically, large numbers of U.S. ground combatants—in 20<sup>th</sup> century warfare—were wounded or killed by artillery shells, which begs the question: Will this remain the case in 2005 to 2020? WWII and Korean conflict wound studies indicate that fragmentation wounds from shell-bursts were the primary cause of infantry WIA and KIA. Behind the statistics of wound studies are the factors leading to the WIAs and KIAs. Perhaps most importantly is resultant destruction of Infantry because of its exposure to enemy observation. The apparent correlation between the degree of exposure of infantrymen to enemy observation and a correspondingly high vulnerability to indirect fire speaks volumes of the utility of not being seen by the enemy.

### **Unattended Ground Sensor Systems (UGS)**

By the far term, some of the advanced UGS systems that are currently under development in the United States and other technologically advanced countries will have become the threat to United States forces in most first-tier and a few second-tier countries. The components in these systems will be much smaller than those in near- and mid-term systems. For instance, the goal of the U.S. Micro-Internettted Unattended Ground Sensor (MUGS) program is to make a single, integrated, signal-processing and communications device—including the miniature sensor, interface, and analog-to-digital converter; digital signal-processor; radio-frequency transceiver; shock-mitigation packaging, and battery power for more than a week's operation under realistic duty cycles—fit into a submunition-sized package<sup>8</sup>.

### **The News Media as an Independent Variable**

“The United States is a democracy responsive to people steeped in Judeo-Christian ethics, who generally respect the spirit, as well as the letter, of laws; fight “fairly,” in accord with “rules,” and find “dirty tricks” repugnant. Free and competitive media representatives

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<sup>8</sup>U.S. Army Infantry Center, Intelligence Operations Division, Directorate Intelligence, Fort Benning, GA, Small Arms Threat.

make it difficult for the government to conduct secret operations. Safeguards against aggression depend primarily upon deterrence and defense, defined mainly in straightforward military terms."

John M. Collins, Green Berets, SEALs, & Spetsnaz: U.S. & Soviet Special Operations.

Will the United States and international media adversely impact upon the U.S. military's aspirations for "speed and information/knowledge"? In the closing decades of the 20<sup>th</sup> century, the battlefield has become somewhat transparent to the eyes and ears of the media. The media's construction of information concerning combat is going to likely be framed by correspondents whose understanding of, or empathy for, the military role is truncated. The absence of the observer's commitment to mission or purpose to which the combat is directed will tend to lead the observer to focus on the attended horrors of war—especially collateral damage. As such, war's horrors tend to be conflated with the instruments of combat—to include small arms systems. This situation is further compounded if the area of operations is a home for tribal, racial, or religious communities. If one looks at such things in an objective manner, friend and foe are differentiated only by the respective levels of carnage attributed to either side. The upshot of such orientation may be a media less inclined to feel supportive of official rationale entailing United States national interests. For all these reasons and more, the media could dramatically impact upon how the U.S. ground combatant is portrayed in battle. All of which prefigures the utter necessity of our minimizing collateral damage—by small arms fire or otherwise.

On a related subject—with regards to technology, information, and the media—Transnational business operations and the transparency of global information systems may add to the proliferation of the new small arms technologies from Western countries to threat countries and/or terrorist. For this reason, we might very well need to cloak our advanced small arms technology from those who might use it against our own forces.

## **Inferences**

The questions from the threat perspective are simply formed—but thankfully not so simply answered: how might they [the threat] develop weapons that will slow our forces down, and how can they foil the efforts of Army leaders to construct useable knowledge? So far, so good for the threat, but war has a troublesome way of foiling one's best laid plans. So, how might we, in seeking to counter countermoves, secure an empathic understanding of the threat? That is to say, can we better understand the actuating motives of the threat weapon developers? To read their doctrine is an opening wedge, but affords no ultimate transparency—nor for that matter does their study of ours place us fundamentally at risk. However, we should try to get inside their minds. Were we able to understand that which is animating them, we would be in a position to preempt their designs, rather than simply react to them. This might prove serviceable in rendering a threat's weapon system obsolete prior to its being fielded. Although this paragraph is admittedly one of common sense made self-reflective, sometimes that which is closest to us is overlooked. Similarly, we should revisit our own motivations—and attempt to see them as the perspective of a prospective threat. In this manner, we might enhance our self-knowledge. For such is the foundation upon which our understanding of others is constructed.

## SUMMARY, RECOMMENDATIONS, AND OPEN QUESTIONS

### Summary

In the final analysis, the future threat to the ground combatant—regardless of the origins—will seek to obviate the effectiveness of our small arms. Perhaps the most important way in which this might be accomplished is to shake our combatant's belief in the reliability of such systems. It is commonplace that the chaos that accompanies the fear and anxiety of combat may shrink the combatant's world to one containing only his comrades, leaders, and his individual or crew-served weapons. In this world all that matters is that his comrades, leaders, or small arms do not seemingly fail him. If he believes that they are there for him, his constancy of resolution may sustain him. It remains a mystery as to where the limits of resolution might be found in combatants, but the unreliability of their small arms systems undercut not only the combatant's ability to continue the fight, but fundamentally serve to erode his faith in the country which he is prepared to stake his life on—for what kind of a country would send him into battle armed with defective weapons? There are a myriad of factors at play in combat. However, the dependability of small arms in the hands of a beleaguered combat team can make the difference between the facilitation of combat discipline and alternatively, the advent of moral dissolution. Lastly, it is important to note that even if all possible technological tools are brought to bear upon the small arms problematic, there remains no substitute for the first class training of ground combatants—both individually and collectively.

In conclusion, it is important to note that just as we are planning to arm and equip the U.S. ground combatant of the future, we can assume that our future adversaries will seek to do the same. Perhaps they will be more successful at it than we. Our industrial might and geographical isolation has historically saved us when we were caught napping, we will assuredly not be so blessed in future war. Our opponents may not allow us the luxury of their standing still while we bludgeon them. Moreover, their ground combatant may prove difficult to find, let alone to wound or kill. One matter for reflection is that the threat's Achilles heel could very well prove to be his under or over reliance upon technology—a situation perhaps ironically mirroring our own.

“From a technological point of view, the real tragedy of Korea was that this great nation [the United States], with its scientific resources and tremendous industrial potential, had to accept combat on the terms laid down by a rather primitive Asiatic army. Neither our imagination nor vision in the years since World War II had given us a combat capability that would provide the technical margin of advantage we needed in land warfare to win decisively and quickly.”

James M. Gavin, 1959, War and Peace in The Space Age.  
(qtd. In Russell F. Weigley, The American Way of War).

### Recommendations

1. Small arms should be adaptable to the realities of asymmetrical combat.
2. The global spread of urban sprawl necessitates weapons that are low-collateral damage capable.

3. Develop projectiles that can seek out the threat—offsetting the classic infantry protection of movement and cover.
4. Rediscover how weapons might attack the morale of a jaded threat.
5. Cloak radically advanced small arms technology from those who might use it against our own forces.
6. Ensure that small arms projectiles are not rendered obsolete by innovations in protective garments.
7. Protect small arms from disabling technologies and build in soft-failure redundancy.
8. Remain proactive in directed energy research and development for small arms.
9. Place engagement distance emphasis—for small arms development—upon the statistical frequency of combat fighting-distances without abandoning long-range as an important metric.
10. Mission specific sniper weapons require more than commercial and/or service- individual weapon makeovers. Snipers deserve a weapon as specialized as they are.
11. Modeling of ground combatants—from a psychological perspective, e.g. human resolve and indomitable will—coupled with wound ballistics need to be factored into the lethality architecture of small arms design.
12. Small arms development must be interdisciplinary in its approach—the how of our newly emerging technology needs to be informed by the what of threat small arms employment in the context of 2005 to 2020 (the object of which this report hopes to initiate).

### **Open Questions**

Crossbows and arrows with lasers: How might the fusion of low and high tech small arms be exploited by a threat?

Might threat micro and larger scale UAVs or other unmanned flying vehicles be used to counter our attempts at battlefield reconnaissance?

What are the weak-links that might develop as a function of the soldier as a system?

Are analog and digital mutually supporting concepts regarding legacy small arms systems?

What does a “911 military” imply for small arms size-weight configuration?

From a future threat’s perspective, what sort of a threat might we appear to be?

What happens when most everyone owns the night?

What is the less likely but most devastating version of a future threat?

Might threat forces adopt and exploit the soldier-as-a-system concept, besting us at our own game?

How flexible need a ground combatant be—as far as their being a battle fought one street down from a civil riot—especially as a player in the “blue-helmeted global village?”

## BIBLIOGRAPHY

### Secondary Sources

- Applegate, Rex, Riot Control Material and Techniques, 2<sup>nd</sup> Edition, Bolder, CO, Paladin Press, 1981.
- Bond, Brian, Liddell Hart, A Study of His Military Thought, New Brunswick, New Jersey, Rutgers University Press, 1977.
- Caeay, Philip J., "The March toward The Future Warrior," Army RD&A: 7-9, July-August 1999.
- Chapman, Anne W.; Lilly, Carol J.; Romjue, John L., "Prepare The Army For War, A Historical Overview of the Army Training and Doctrine Command 1973-1998," Fort Monroe, VA, US Army Training and Doctrine Command, 1998.
- Clausewitz, Karl Von, 1832, On War, New York: Random House, 1943.
- Collins, John M., Green Berets, SEALs, & Spetsnaz: U.S. & Soviet Special Operations, New York, Pergamon-Brassey's, 1987.
- Corum, James S., The Roots of Blitzkrieg, Hans von Seeckt and German Military Reform, Lawrence, Kansas, The University Press of Kansas, 1992.
- DeCosta, Peter and Crivello, Edward, "New Soldier Technologies." Army RD&A: 5-6, July-August 1999.
- Ezell, Edward C., Small Arms of the World, 12<sup>th</sup> Edition, Harrisburg, PA, Stackpole Books, 1983.
- Ezell, Edward C., Small Arms Today, 2<sup>nd</sup> Edition, Harrisburg, PA, Stackpole Books, 1988.
- Glenn, Russell W., We Band of Brothers, The Call for Joint Urban Operations Doctrine, Santa Monica, CA, RAND, 1999.
- Glenn, Russell W., Fighting in Hell: A Consideration of Constrained Urban Warfare Operations Doctrine, Santa Monica, CA, RAND, 1994.
- Hallahan, William H., Misfire, The History of How America's Small Arms Have Failed Our Military, New York: Charles Scribner's Sons, 1994.
- Hart, Basil Liddell 1976. The Sword and The Pen, Selections from the World's Greatest Military Writings, New York, Thomas Y. Crowell Company.
- Hogg, Ian V., Military Small Arms of the 20<sup>th</sup> Century, 6<sup>th</sup> Edition Northbrook, IL, DBI Books, 1985.
- Hogg, Ian V., The Weapons That Changed The World, New York, Arbor House, 1986.
- Huston, James A., The Sinews of War: Army Logistics 1775-1953, Washington DC, U.S. Government Printing Office, 1966.



- Jette, Bruce D. and Brower, Bill, "The Soldier As A System," Army RD&A: 3-4, July-August 1999.
- Junger, Ernst., 1929, The Storm of Steel, Trans. In Stahlgewitten. New York, Howard Fertig, Inc. 1996.
- Kuhn, Thomas S., The Structure of Scientific Revolutions, Chicago, IL, The University of Chicago Press, Ltd, 1962.
- Laqueur, Walter and Alexander, Yonah, The Terrorism Reader, The Essential Source Book On Political Violence Both Past And Present, New York, A Meridian Book, 1978.
- Manunta, Roberto, "Making Sense of Terrorism." INTERSEC, The Journal of International Security, 362-364, November/December 1999.
- Marshall, Evan R. and Sanow, Edwin J., Handgun Stopping Power, The Definitive Study, Bolder, CO, Paladin Press, 1992.
- Marshall, S.L.A, 1947, Men against Fire, The Problem of Battle Command in Future War, Gloucester, MA, Peter Smith, 1978.
- Liang, Qiao and Xiangsui, Wang, Unrestricted Warfare, Beijing, PLA Literature and Arts Publishing House, 1999.
- Walter Millis, Walter, American Military Thought, New York, The Bobbs-Merrill Company, Inc, 1966.
- Obusek, John P., "Warfighter Physiological Status Monitoring," Army RD&A, 10-12, July-August 1999.
- Peters, Ralph, Fighting for the Future, Will America Triumph?, Mechanicsburg, PA, Stackpole Books, 1999.
- Pinker, Steven, How the Mind Works, New York, W.W. Norton & Company, 1997.
- Poland, James M., Understanding Terrorism, Groups, Strategies, and Responses, Englewood Cliffs, N.J., Prentice Hall, 1988.
- Preston, Richard A.; Roland, Alex; and Wise, Sydney F., Men In Arms, A History of Warfare and its Interrelations with Western Society, Orlando, FL., Harcourt Brace Jovanovich, 1991.
- Romjue, John L., American Army Doctrine for the Post-Cold War, Fort Monroe, VA, US Army Training and Doctrine Command, 1996.
- Sasser, Charles W. and Roberts, Craig, One Shot-One Kill, American Combat Snipers, World War II, Korea, Vietnam, Beirut, New York, Simon & Schuster Inc, 1990.
- Senich, Peter R., The Complete Book of U.S. Sniping, Bolder, CO, Paladin Press, 1988.
- Senich, Peter R., Limited War Sniping, Bolder, CO, Paladin Press, 1977.

Siddle, Bruce K., Sharpening The Warrior's Edge, The Psychology & Science of Training, Millstadt, IL, PPCT Publications, 1995.

Siuru, William, Advances in Unmanned Flight, Planes Without Pilots, New York, McGraw-Hill, Inc., 1991.

Steadman, Nick, "Weapon Upgrades '99," INTERSEC, The Journal of International Security, pp. 356-358, November/December 1999.

Alvin and Heidi Toffler, War and Anti-War, Survival at the Dawn of the 21<sup>st</sup> Century, Boston, MA, Little Brown and Company, 1998.

Weigley, Russell F., The American Way of War, Bloomburg, Indiana, Indiana University Press, 1973.

Weigley, Russell F., History of the United States Army, New York, The Macmillan Company, 1967.

Williams, F.D.G., SLAM The Influence of S.L.A. Marshall on the United States Army, Fort Monroe, VA, US Army Training and Doctrine Command, 1994.

#### **Audiocassette**

The Art of War. By Sun Tzu, translated by Thomas Cleary and read by David Warrilow. Shambhala Publications, Inc. 1989.

#### **Briefing**

Dale Malabarba, Director, Modeling & Analysis. Future Threats To The Soldier System, U.S. Army Natick Soldier Center, Natick, MA. 19 October 1999.

#### **Official Documents**

1. U.S. Air Force Scientific Advisory Board, no document number, New World Vistas Air and Space Power for the 21<sup>st</sup> Century—Directed Energy Volume, 15 December 1995.

2. The Joint Services Small Arms Program, Contract No. DAAL03-91-C-0034, TCN 97-047, Future Small Arms Conclave, "Blue-Sky" -2020, September 1997.

3. The Joint Services Small Arms Program, Technical Report ARCCD-TR-93012, 1992 Future Technology Conference, June 1993.

4. The Joint Services Small Arms Program, no document number, The Joint Services Small Arms Master Plan, 5 October 1998

5. U.S. Army Infantry Center, Intelligence Operations Division, Directorate Intelligence, Fort Benning, GA, no document number, Small Arms Master Plan Threat, 7 January 2000.

6. National Defense University Washington DC, International Issues And Perspectives, 1986.

7. Army Research Laboratory, no document number, Future Soldier Technologies Workshop, Final Report, Volumes 1 & 2, 16 December 1994.
8. NATO Army Armaments Group Panel III On Close Combat – Infantry Programme For Collaborative Research Into Small Arms technology (CRISAT Programme) Technology Area 1 Target Definition Final Report, 4 July 1994.
9. Infantry Weapon Trends and Projections—Worldwide Developments in Soldier Capabilities, June 1996, NGIC-1149-652-96.
10. Developments in Foreign Soldier system/Soldier Modernization Programs, NGIC-1100-55J-98, 27 February 1998.
11. Soldier Capabilities & Equipment, Volume 1, Peacekeeping and Peacekeeping Equipment, NGIC-1149-652-95, May 1995

**APPENDIX**  
**INTELLIGENCE ASSESSMENT**

## WEAPONS

Through the year 2020, the primary role of the infantryman in combat operations will continue to be to close with and destroy enemy forces, to hold or capture ground, and to separate elements of the enemy so that they can be destroyed in detail. Regardless of the intensity of the conflict, the dismounted ground combatant in a small arms environment will be required to fight in built-up areas and in close terrain against elusive and fleeting targets. (1)

Infantrymen will continue to be armed with small arms, which are predominantly oriented to dismounted operations. However, recent political changes are likely to have important repercussions on infantry weapons. Western European and North American armies will decrease significantly in numbers, so fewer new-generation small arms will be required. This reduction in force size also will limit the amount of business for major arms producers. With shrinking markets and tougher competition, traditional small-arms manufacturers will realize that in view of the maturity and quality of weapons they previously built, it will be difficult to convince their smaller and less-affluent armed forces to adopt new designs. Also, after a century of technological evolution, currently available kinetic-energy infantry weapons represent a very mature technology in which further advances are likely to yield only marginal improvements. (1)

Only the United States and a few other Western countries (e.g., France and the United Kingdom) are pursuing the development of "leap-ahead" technologies. These will combine the point-target effectiveness of kinetic-energy bullets with the area-target efficacy of high explosive, air-bursting grenades into an integrated rifle system. The U.S. Objective Individual Combat Weapon (OICW) and Objective Crew-Served Weapon (OCSW) both call for a fire-control system (FCS) that processes data received from a highly accurate laser rangefinder, automatically adjusts the system's electro-optic (EO) devices (i.e., its aimpoint assist and day/night sighting equipment), and programs its grenade fuzes with the ranging data. Also, unlike the M16/M203 rifle/grenade-launcher configuration, which can fire only one 40-mm grenade at a time before it has to be reloaded, the OICW will have a magazine for at least six 20-mm grenades. The increased accuracy and additional area-target capability afforded by weapon systems like the OICW or the OCSW should dramatically increase the lethality of the forces that carry them. However, even a limited threat to the infantryman from these types of systems likely will not be realized until around 2020. (2)

Although an integrated weapon system that combines kinetic projectiles and bursting munitions with highly accurate fire control and aiming will not be a significant threat to the infantryman through 2020, rifles with enhancement devices (i.e., optical, electro-optical, and fire-control systems designed to improve small-arm firing accuracy) will make rifles of all types a more serious threat. Optical systems (e.g., ring sights, aiming lights, and red-dot collimators) and EO devices (e.g., first- and second-generation image-intensifiers ( $I^2$ )) are being used by elite forces and border troops of potential threat countries now, and regular forces will be using these devices in large numbers by around 2010. After 2010, third-generation  $I^2$  and thermal imagers will begin replacing the first- and second-generation systems and will become the norm by 2015. Fire control systems that integrate a laser rangefinder with the rifle's EO and optical systems will slowly increase in usage from around 2015 to 2025, and become a credible threat to the infantryman by the end of that period. (2)

## **IMPROVED PERSONAL PROTECTION**

Today, thanks to advances in textile technology, highly effective, lightweight body armor is readily available and inexpensive enough for even poor countries and terrorist groups to outfit at least some of their forces with it. Body armor producers now offer relatively lightweight, bullet-resistant armor plates as add-ons to a fragmentation vest. With the addition of these plates, today's body armor is effective against many high-velocity rifle rounds. Therefore, more and more military and non-military groups are beginning to wear these protective garments, tailored to their mission needs, on a regular basis. (2)

## **AMMUNITION**

As a result of the proliferation of modern body armor, and coupled with the increasing use of light-armored vehicles, the use of armor-piercing (AP) bullets against both materiel and human targets will become commonplace by 2015. Numerous ammunition firms offer 7.62 x 51-mm AP rounds, and, although currently only a few manufacturers sell 5.56-mm AP rounds, additional manufacturers undoubtedly will sell them in the near future. AP rounds in 5.45 x 39-mm and 7.62 x 39-mm calibers also are available, and their use will expand as well. (2)

## **PROJECTIONS**

### **Casualty-Causing Threats** - (Ranked from Highest to Lowest)

**Fragment and bullet threat:** Fragments and bullets (in that order) are expected to cause the greatest number of actual combat casualties through 2020. Delivery systems include artillery, rockets, mines, grenades, small arms, and machineguns.

**Blast-weapons threat:** Because of their effective use in recent conflicts, fuel-air explosives, including thermobaric (blast/incendiary) systems, probably will be acquired in greater numbers through 2020 than might have otherwise been the case. Blast weapons are a significant threat to the ground combatant, especially when utilized in a defensive role.

**Laser threat:** Low-energy laser weapons pose a hazard to both human eyes and optical systems. Many countries are importing laser technology. As a result, low-energy laser weapons, including "tunable" lasers, will likely pose a threat to the infantryman by 2010. High-energy lasers are not a direct threat to the infantryman.

**Flame and incendiary threat:** Flame and incendiary weapons are presently in the inventories of a limited number of adversarial countries. These weapons will continue to be a threat to the ground combatant through 2020. Many classic stream-of-burning-liquid flamethrowers will be replaced within the next 10 years with shoulder launchers that fire rocket-propelled incendiary, incendiary/blast, and smoke rounds.

**Chemical, biological, and nuclear (CBN) threat:** Chemical, biological, and nuclear weapons (in that order) will continue to be a threat on the battlefield. Since the Gulf War, many likely adversaries have placed more emphasis on their CBN (especially chemical) capabilities, increasing the likelihood of the ground combatant coming in contact with these weapons on the battlefield.

**Radiofrequency (RF)-weapon threat:** The threat to the infantryman from RF weapons is assessed to be very low. While the first RF weapons could be fielded shortly after the turn of the century, they likely will be designed for use against high-value targets, such as aircraft or radars, rather than against individual soldiers or their equipment. (2)

**Performance-Degrading Threats** – Ranked from Highest to Lowest

**Surveillance threat:** The threat to the ground combatant from enhanced-vision devices and other RSTA equipment is significant. By 2000, many countries will be using second-generation image intensifiers, first-generation thermal sensors, and low-light-level television systems. Third-generation image intensifiers will proliferate by 2010.

**Obscurant threat:** Obscurants are likely to pose a severe threat to the infantryman's electro-optic systems. Most threat countries currently are able to obscure the visual through the far-infrared regions of the electromagnetic spectrum; they are projected to be able to obscure from the visual to the centimeter-wave regions by 2010.

**Electronic-warfare threat:** The direct threat to the ground combatant from electronic warfare is not expected to be serious. Most adversaries will use their limited electronic-warfare assets on a higher level U.S. communication systems rather than on the infantryman's communication systems. However, the individual soldier will be vulnerable to the misinformation and communications problems generated by adversarial targeting of higher level U.S. information systems. (2)

**Sources:**

U.S. Army National Ground Intelligence Center (NGIC), NGIC-1142-208-98, Infantry Weapons Trends and Projections-Worldwide (U), July 1998.

NGIC, NGIC-1149-136-98, Future Threat to the Soldier System (U), March 1998.

(U) In low- and mid-intensity conflicts, the infantry will be required to conduct dismounted operations against a lightly equipped enemy force. Intelligence information may be limited, and the enemy can be expected to exploit the element of surprise; he may well present only a fleeting target. The enemy can be expected to be trained in the use of mortars, pistols, rifles, light machineguns, crew-served weapons, mines, and other explosive devices. (6)

(U) In a high-level conflict, the threat to the infantry will be characterized by a preponderance of armor and mechanized infantry, supported by massive indirect fire and tactical air support. (6)

(U) The weapon system and associated equipment must work while subjected to enemy countermeasures, adverse weather conditions, and battlefield obscuration. It is important that the time from target acquisition to weapon firing is as short as possible and that a new target can be engaged as soon as possible upon the completed engagement of the present target. (6)

(U) The pace of technological advance in infantry weapons is governed by three general factors: design innovations, new materials, and advances in ammunition. The first two are strongly interrelated--design is usually influenced by the availability of new materials. Materials and ammunition are constantly being improved, and the work being done in these areas offers some insight into future weapons. (6)

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